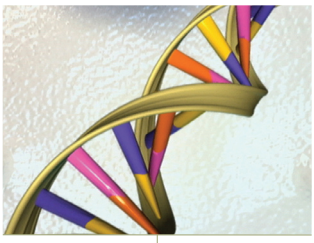
What is Agricultural Biotechnology?

For about 10,000 years , farmers have been improving wild plants and animals through the selection and breeding of desirable characteristics. This breeding has resulted in the domesticated plants and animals that are commonly used in crop and livestock agriculture. In the twentieth century, breeding became more sophisticated, as the traits that breeders select for include increased yield, disease and pest resistance, drought resistance and enhanced flavor. Traits are passed from one generation to the next through genes, which are made of DNA. All living things—including the fruits, vegetables and meat that we eat—contain genes that tell cells how to function. Recently, scientists have learned enough to begin to identify and work with the genes (DNA) that are responsible for traits.



DNA is the key to biotechnology

WHAT IS AGRICULTURAL BIOTECHNOLOGY?

Agricultural biotechnology is a collection of scientific techniques used to improve plants, animals and microorganisms. Based on an understanding of DNA, scientists have developed solutions to increase agricultural productivity. Starting from the ability to identify genes that may confer advantages on certain crops, and the ability to work with such characteristics very precisely, biotechnology enhances breeders' ability to make improvements in crops and livestock. Biotechnology enables improvements that are not possible with traditional crossing of related species alone.

HOW IS AGRICULTURAL BIOTECHNOLOGY USED?

Genetic engineering: Scientists have learned how to move genes from one organism to another. This has been called genetic modification (GM), genetic engineering (GE) or genetic improvement (GI). Regardless of the name, the process allows the transfer of useful characteristics (such as resistance to a disease) into a plant, animal or microorganism by inserting genes (DNA) from another organism. Virtually all crops improved with transferred DNA (often called GM crops or GMOs) to date have been developed to aid farmers to increase productivity by reducing crop damage from weeds, diseases or insects.

Molecular markers: Traditional breeding involves selection of individual plants or animals based on visible or measurable traits. By examining the DNA of an organism, scientists can use molecular markers to select plants or animals that possess a desirable gene, even in the absence of a visible trait. Thus, breeding is more precise and efficient. For example, the International Institute of Tropical Agriculture has used molecular markers to obtain cowpea resistant to bruchid (a beetle), disease-resistant white yam and cassava resistant to Cassava Mosaic Disease, among others. Another use of molecular markers is to identify undesirable genes that can be eliminated in future generations.

Molecular diagnostics: Molecular diagnostics are methods to detect genes or gene products that are very precise and specific. Molecular diagnostics are used in agriculture to more accurately diagnose crop/livestock diseases.

Vaccines: Biotechnology-derived vaccines are used in livestock and humans. They may be cheaper, better and/or safer than traditional vaccines. They are also stable at room temperature, and do not need refrigerated storage; this is an important advantage for smallholders in tropical countries. Some are new vaccines, which offer protection for the first time against some infectious illnesses. For example, in the Philippines, biotechnology has been used to develop an improved vaccine to protect cattle and water buffalo against hemorrhagic septicemia, a leading cause of death for both species.

Tissue culture: Tissue culture is the regeneration of plants in the laboratory from disease-free plant parts. This technique allows for the reproduction of disease-free planting material for crops. Examples of crops produced using tissue culture include citrus, pineapples, avocados, mangoes, bananas, coffee and papaya.

Contributors to this brief:

U.S. Agency for International Development, Agricultural Biotechnology Support Project II, and the Program for Biosafety Systems

A B S P II

PBS PROGRAM FOR BIOSAFETY SYSTEMS

** PBS & ABSPII are supported by the United States Agency for International Development*

Irrigated genetically engineered cotton field in South Africa.

HOW LONG HAS BIOTECHNOLOGY BEEN USED IN AGRICULTURE AND FOOD PRODUCTION?

The first food product of biotechnology (an enzyme used in cheese production and a yeast used for baking) appeared on the market in 1990. Since 1995, farmers have been growing GE crops. In 2003, 7 million farmers in 18 countries—more than 85 percent of them resource-poor farmers in the developing world—were planting biotech crops. Almost one third of the global biotech crop area was grown in developing countries.

WILL AGRICULTURAL BIOTECHNOLOGY HAVE ECONOMIC AND SOCIAL IMPACTS?

A safe and sufficient food supply, grown in an environmentally responsible fashion, is essential for humanity. Like any technology, agricultural biotechnology will have economic and social impacts. Since their introduction, crops improved using biotechnology have been used safely, with benefits such as the reduction of pesticide use. Agricultural biotechnology is only one factor among many influencing the health and welfare of farmers and other citizens in the developing world. As biotechnology continues to evolve, factual and open public discourse is vital to define the role it should play in society.

Sources:

Agricultural biotechnology: What are the issues? The Land Grant University Brochure, Cornell University, College of Agriculture and Life Sciences (http://www.nysaes.cornell.edu/comm/gmo/PDF/GMOLandGrant.pdf)

Genetically Engineered Organisms - Public Issues Education Project, Cornell University (http://www.geo-pie.cornell.edu/)

James, C. 2003. Preview: Global Status of Commercialized Transgenic Crops: 2003. ISAAA Briefs No. 30. Ithaca, NY

Ives, C. L., Johanson, A., Lewis. J. (2001). Agricultural Biotechnology: A Review of Contemporary Issues. USAID.